DOE Accident Prevention and Investigation

Bi-Annual Summary Report

U.S. Department of Energy ▪ Office of Health, Safety and Security ▪ AI-2011-01 ▪ June 1, 2011

Federally Led Accident Investigation:

Building 488 Tree Felling Injury at Brookhaven National Laboratory, March 5, 2011

Type B Accident Investigation:

Radiological Contamination Event During Separations Process Research Unit Building H2 Demolition, September 29, 2010

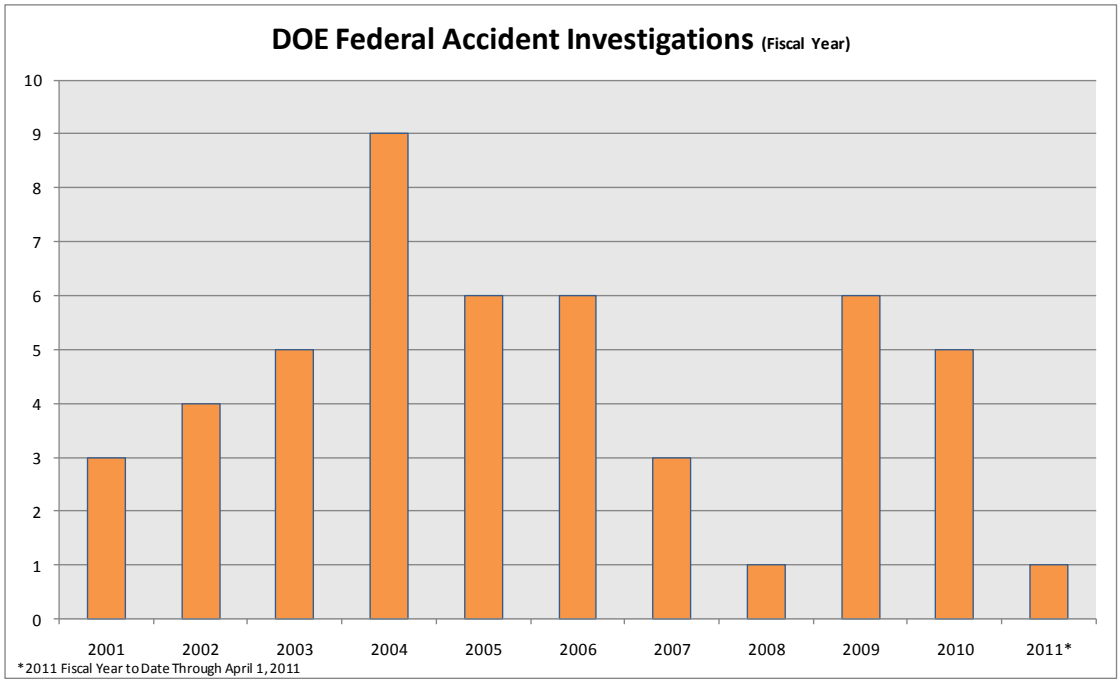
This series of reviews is intended to provide summary analyses of federally appointed investigations conducted by the Department of Energy (DOE). The goal of conducting these reviews and analyses is to provide DOE and contractor management with an overview of the safety management system weaknesses identified and discussed in each of the investigation reports and related occurrence reports on file in the Occurrence Reporting and Processing System (ORPS) database.

The Office of Health, Safety and Security (HSS) encourages both DOE and contractor management to review these reports and use the information provided to assess the identified weaknesses against current work practices to ensure a safe work environment.

Accident Investigations Completed:

ORPS Event	Description	Investigation Initiated
EM--WGI-G2H2-2010-0001	Radiological Contamination Event During Separations Process Research Unit Building H2 Demolition, September 29, 2010	October 22, 2010
SC--BHSO-BNL-BNL-2011-0005	Building 488 Tree Felling Injury at Brookhaven National Laboratory, March 5, 2011	March 8, 2011

Overall Condition: Historical Perspective

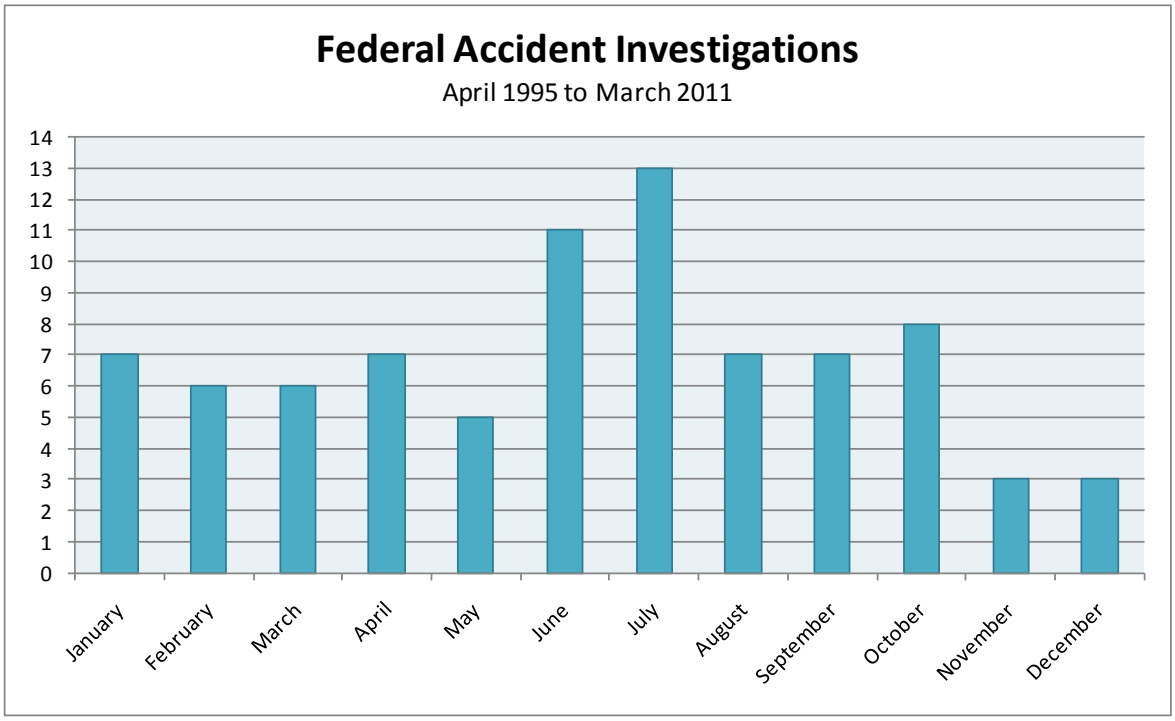


On March 4, 2011, DOE O 225.1B, *Accident Investigations*, was approved by the DOE Deputy Secretary. This revision to the accident investigation order incorporated a number of changes, including how the need for an accident investigation is determined and how the Accident Investigation Board is appointed. Another change in the order eliminated the Type A/Type B consequence differentiation. If an investigation is determined necessary by the Head of the Headquarters Element, it will now initiate a DOE Federal Investigation.

For DOE as a learning organization, the principal goal of the Accident Prevention and Investigation Program is to understand what happened, why it happened and what needs to be done to prevent recurrence of accidents. One goal of this report is to provide information that can be used toward prevention of accidents by becoming alert to identified weaknesses in the Integrated Safety Management Systems and human performance as they are implemented and practiced throughout the DOE complex.

Historical Perspective: Monthly Frequency of Accident Investigations

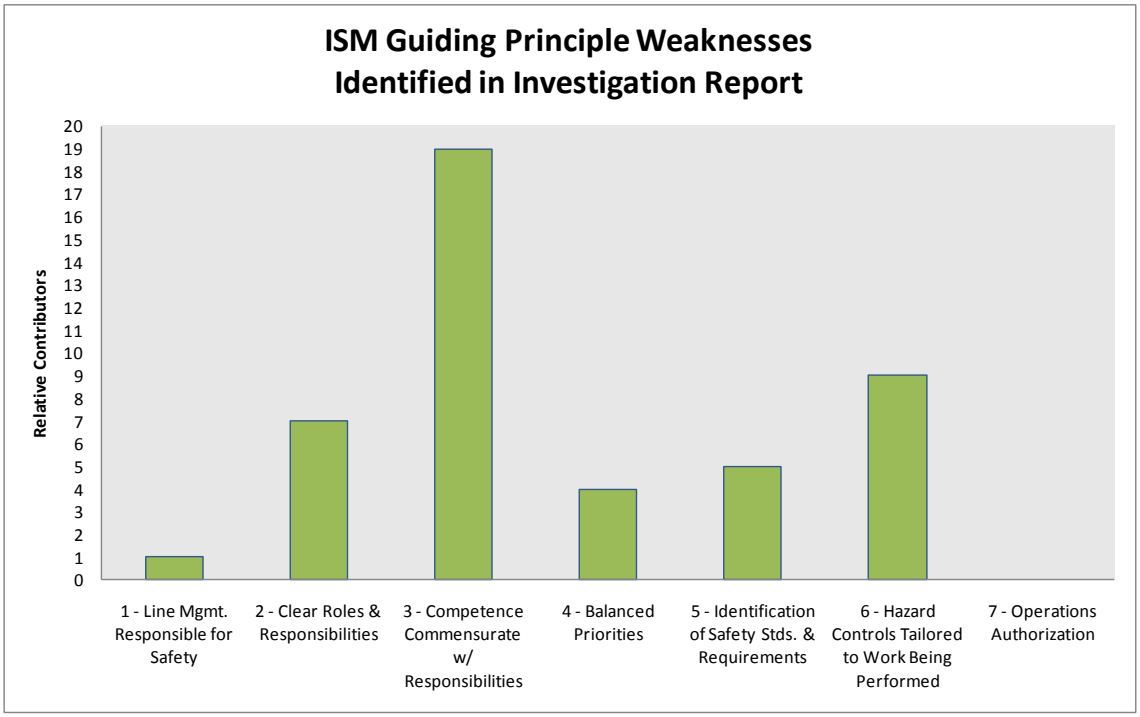
HSS reviewed the federally led investigations since 1995 to determine the annual recurrence of operational events and conditions warranting the establishment of accident investigation boards. The chart below shows a notably higher recurrence of such situations in June and July of each year. Also of note, prior to the recent change in the accident investigation order, there were no "formerly-Type A" investigations conducted in the months of May or November in that time frame.



Causal Analysis Summary

HSS reviewed the two reports completed this period with special emphasis on the analyses and conclusions presented in each of the investigation reports. The conclusions and contributing causes as listed in the investigation reports were reviewed and summarized. The summary causes from these reports were binned and assessed against the Integrated Safety Management (ISM) *Guiding Principles* and *Core Functions.*

ISM Guiding Principles



ISM Guiding Principle 3 – Competence Commensurate with Responsibilities – Was identified by both investigation boards as the greatest safety management system weakness in each of their investigation reports. Those weaknesses were identified and discussed at both the worker and management levels within the organizations resulted in specific contributing factors and conclusions.

ISM Guiding Principle 6 – Hazard Controls Tailored to the Work Being Performed – Was identified as the second greatest contributor to safety management system weaknesses.

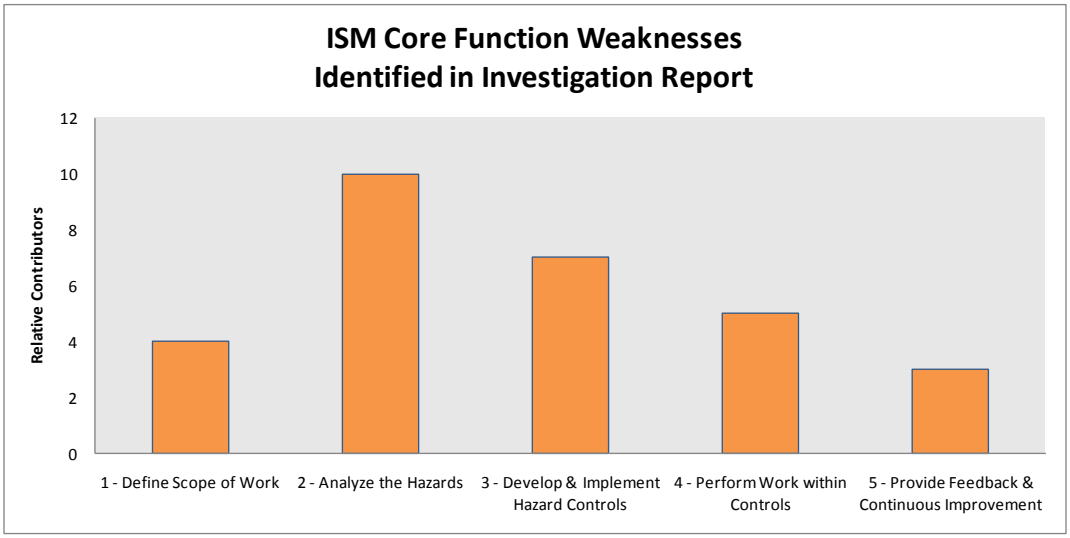
In comparison to the investigation reports, the available data from ORPS reports for the involved sites and program offices for the previous six months indicated *Management Problem* (ORPS CAT Tier 1, A4) deficiencies as the greatest contributor over all operational events filed. The second level (ORPS CAT Tier 2) greatest contributors were *Management*

Methods LTA (B1) and *Work Organization & Planning LTA* (B3). Worthy of note, this represents no change in the observations made in the previous Semi-Annual Report, however; the major contributor to this data was BNL, as SPRU filed no occurrence reports in the six months prior to that event.

In assessing the safety management systems overall, these attributes couple well between the Guiding Principles, whose function is to establish the safety systems, and the Core Functions whose purpose is to control the performance of work. Managers and oversight personnel should be alert to ensure the safety systems appropriately match hazard controls to the risk and potential consequences during the performance of work.

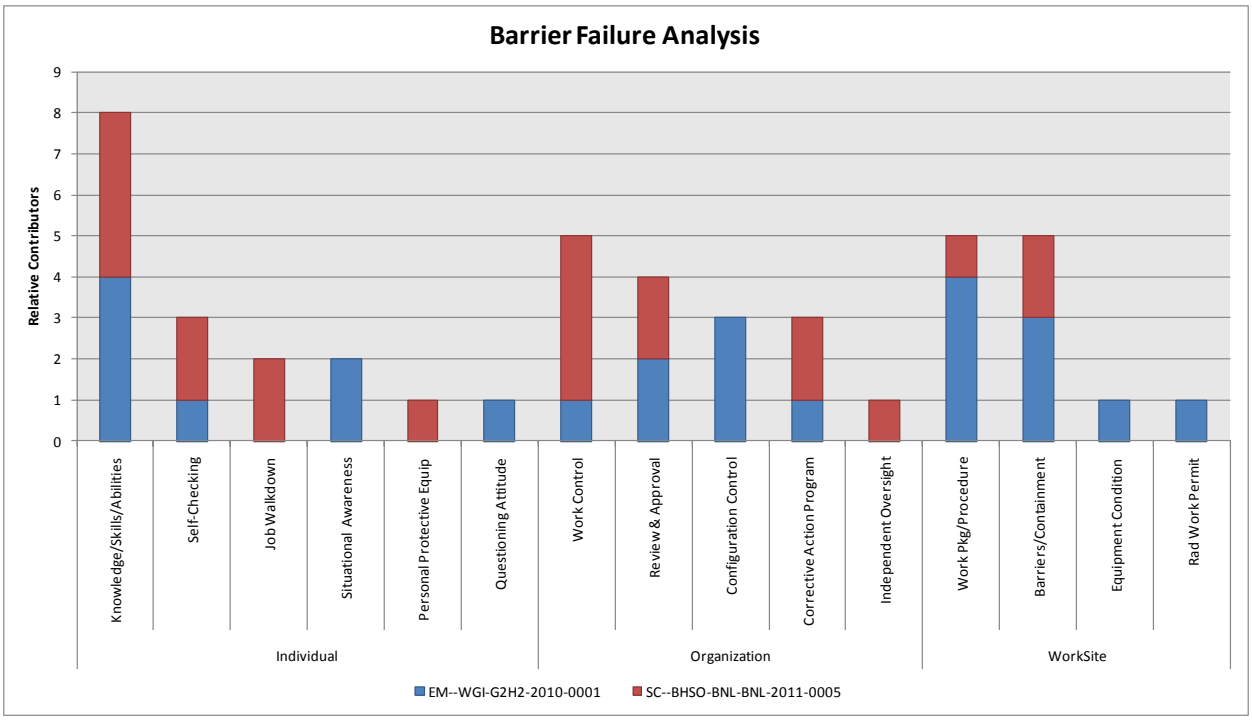
ISM Core Functions

Failures to analyze the hazards, and develop and implement hazard controls were the most frequently cited weaknesses identified in the investigation reports. This general theme was also identified in a review of the six months' prior occurrences reported by BNL. Failing to identify these weaknesses in the work planning and execution processes provided a lost opportunity for improving any and all work processes. SPRU filed no occurrence reports in the six months prior to the event of September 29, 2010.



Managers and oversight personnel should include reviews of work planning and control documents at their facilities to assure those documents include formalized hazard identification sufficient to apply the appropriate hazard controls prior to the execution of work. Management observations of work in progress should be in place to capture workers' actions in response to written work instructions and adherence to performing work steps within the established controls.

Barrier Failure Analysis



Barrier failures were identified in each of the two investigation reports. HSS classifies barrier failures into three levels: the individual, the work site and the organization. The most common barrier failures identified in both reports related to *Knowledge, Skills and Abilities* of personnel. These weaknesses were apparent at the worker level, work planning and management levels responsible for the review and authorization of work documents. Failures to recognize hazards for the work to be accomplished by those planning, reviewing and authorizing work were also common to both investigations. Correspondingly, these issues were manifested in work planning documents which did not *identify, implement and control hazards* associated with the work to be accomplished.

Whether grouping causal factors into ISM categories or the newer HSS Barrier Failures method of grouping causal factors, the results indicate that failures in hazard identification and control, and worker competencies were the leading contributors to these accidents. Managers should take steps to assure on a regular basis that their work planning and execution, including worker competencies, are meeting the rigor necessary to perform work safely.

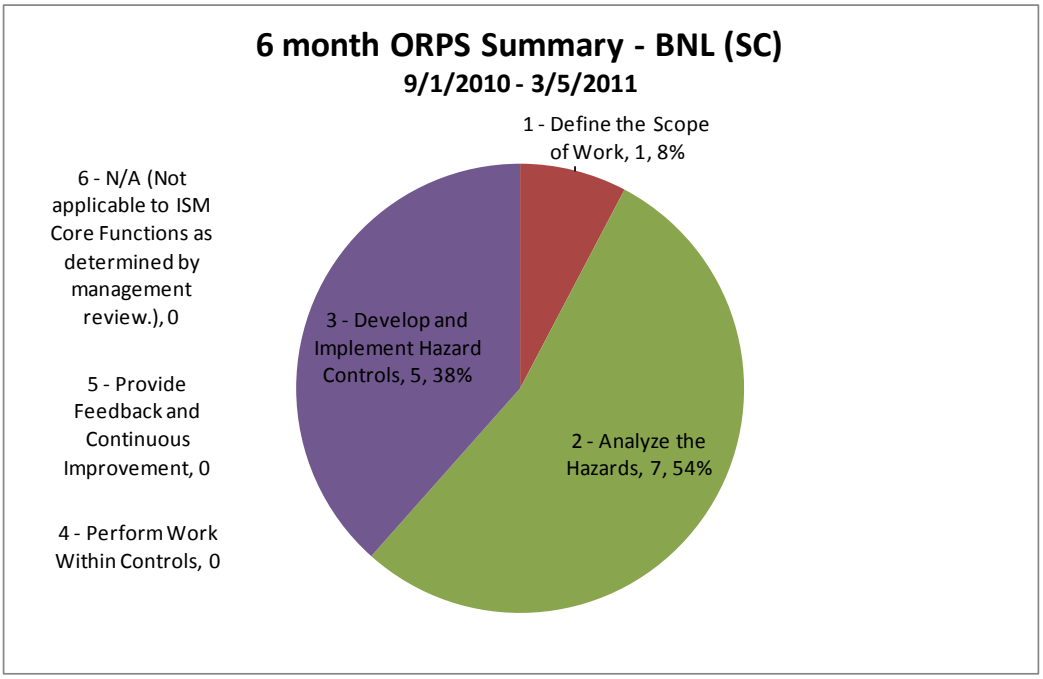
Occurrence Reporting and Processing System Precursor Analysis

HSS conducted a review of occurrence reports filed at each of the sites and respective program offices involved in the accident investigations for the six months prior to the respective accidents. BNL-SC had on file 10 occurrence reports, while SPRU (WGI) filed no occurrence reports for the six month period. SPRU filed only one occurrence report in the year prior to the contamination event.

The ORPS requires the selection of one or more ISM codes when entering an occurrence into the system. However, the ORPS field accommodates only codes related to the five Core Functions. The selection includes six codes: One through Five for the five Core Functions and Six, "N/A." ISM Guiding Principles are not accommodated in the ORPS entry forms.

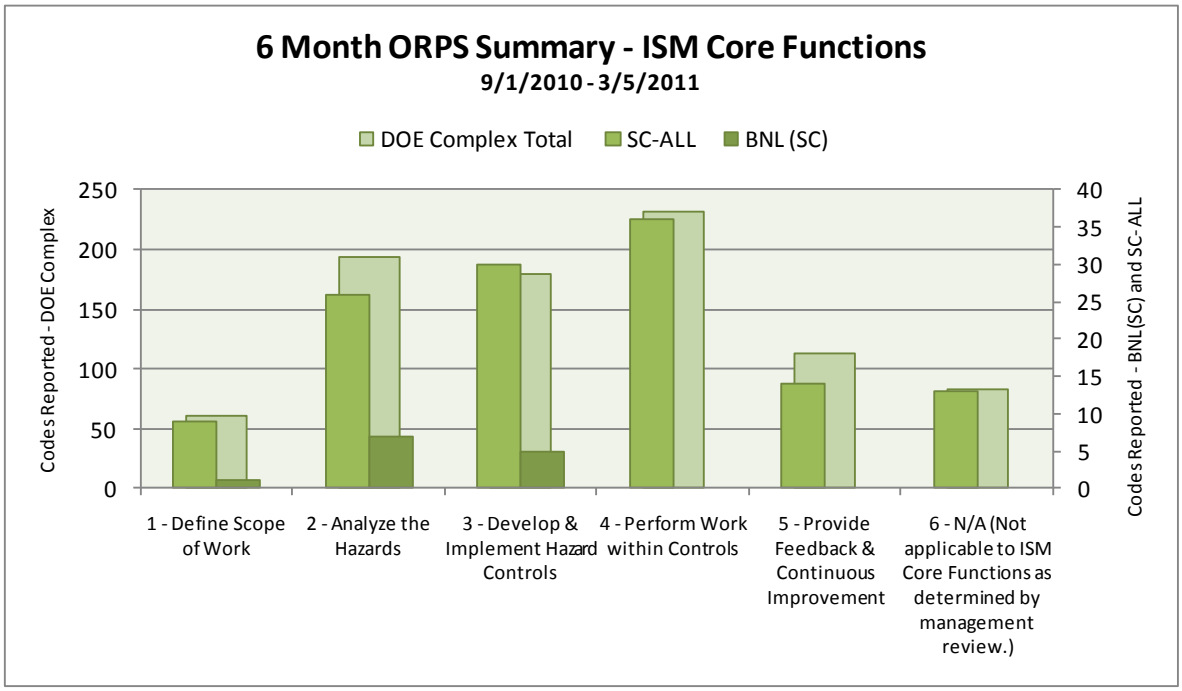
Brookhaven National Laboratory

Brookhaven National Laboratory (BNL-SC) filed 10 occurrence reports in the six months prior to the tree felling accident. In 54% of those reported events, Facility Management identified a failure to analyze the work hazards as the most frequent ISM Code. Accordingly, the next most cited ISM Code was the failure to develop and implement hazard controls. This observation tracks with the findings of the accident investigation board for the tree felling accident.



A review was conducted of the ORPS reports filed by BNL prior to the accident comparing those to reports filed in the Office of Science (SC) and the DOE Complex for the same

period. While it is difficult to place statistical significance to the ten reports, the following was noted: The reports filed by both SC and DOE showed Core Function 1, *Define the Scope of Work*, as the least troubling contributor, as did BNL. However, both SC and DOE Complex reports identified Core Function 4, *Perform Work Within Controls*, as the greatest contributing cause while BNL did not identify Core Function 4 as a contributor in any of their ten reports. By contrast, BNL identified Core Function 2, *Analyze the Hazards*, as the greatest contributor in those ten reports.



Separations Process Research Unit

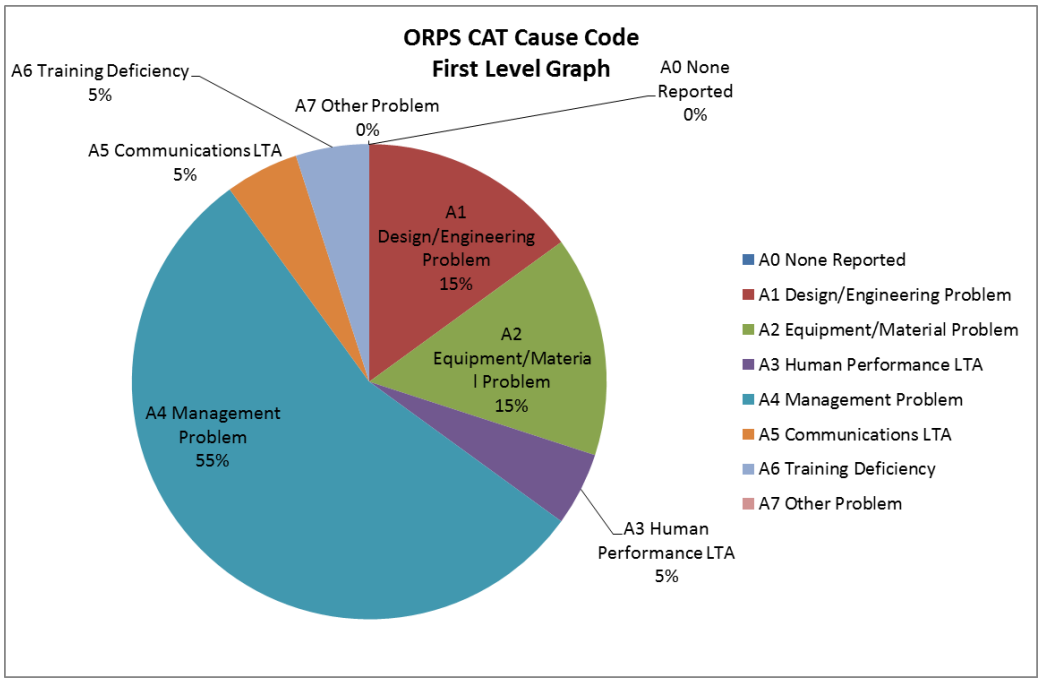
On December 13, 2007, DOE announced the award of a four-year task order to Washington Group International (WGI) to provide deactivation, demolition, and removal of the SPRU nuclear facilities (Buildings G2, H2, the Tank Enclosures, and the connecting tunnel); cleanup and environmental restoration of the underlying and surrounding contaminated soil; and the decontamination of piping tunnel connecting the SPRU facilities to other operating facilities.

WGI was awarded additional funding from the American Recovery and Reinvestment Act by DOE to cover the costs associated with the current task order work scope as well as to accelerate the completion of the WGI contract scope from December 2011 to September 2011.

In the six months prior to the contamination event, SPRU (WGI) filed no occurrence reports. In the previous year, SPRU filed one occurrence report for the G2/H2 facilities work activities.

ORPS Precursor Analysis Summary

At BNL, a review of the ORPS reports for the six months prior to the tree felling injury accident indicated the leading cause attributed to operational events was "Management Problem." This observation is in agreement with the conclusions of the investigation board.



During the six months prior to the radiological contamination event at SPRU, WGI filed no reports of operational events at SPRU in the ORPS system. Since its December 2007 contract award for the SPRU D&D work, WGI filed one occurrence report in ORPS for an arc flash event. Because only one report was filed in the previous ~2-1/2 years, there is not a sufficient basis to conduct an analysis of the safety management system responses to noted events.

Human Performance Improvement Considerations

Human Performance Improvement (HPI) is about reducing errors and managing defenses to prevent significant events. The application of HPI principles in numerous organizations (medical, nuclear, chemical, etc.) has resulted in improved safety, quality, and productivity. HPI is not a program, but rather a distinct way of thinking based on a performance model that illustrates the organizational context of human performance.

ORPS allows multiple causal factors to be associated with any one event. Of the 12 BNL reports reviewed by HSS only one report attributed Human Performance (ORPS CAT Tier 1, A3) as a causal factor In that report BNL identified the second tier causal factor as Rule Based Error (ORPS CAT Tier 1, A3B2). With this little data available, it is difficult to draw any statistical or meaningful conclusion.

Conclusion

The overall trend in federally-led accident investigations is declining, following an increase in FY-2009. Management should be alert that the recent revision of DOE O 225.1B, *Accident Investigations*, raises most thresholds for determining whether a federally-led investigation is required. Along with that change the order also now requires that the rationale for those determinations be documented.

In both investigation reports completed this period, the boards concluded personnel competencies represented the greatest area of safety management system weakness. Failures to identify and control hazards associated with the work to be performed contributed significantly to the unwanted consequences resulting in the accident situations.

During the six months prior to the radiological contamination event at SPRU, WGI filed no reports of operational events at SPRU in the ORPS system. Since its December 2007 contract award for the SPRU D&D work, WGI filed one occurrence report in ORPS for an arc flash event. While safe and compliant operations and work practices are reflective of all learning organizations, the investigation board identified several events that, in their opinion, warranted notification and action through the ORPS process. Those unreported events represented a lost opportunity to identify and correct safety management system weaknesses with a higher level of rigor.

BNL facilities reported 12 operational events in the six months prior to the tree felling injury accident. The subjects of these operational events were varied and did not hint at any specific operational area of concern.

This report does not include a review of planned and unplanned work place and work planning and control assessments that may have been conducted by either BNL, WGI (SPRU) or DOE Management. However, this does point to an opportunity for both contractor and DOE Management to assess performance as reported and recorded in the ORPS data system and use those results to guide oversight activities.

Accident Investigation Report Summaries

This section contains summaries for the two accident investigations in this report. Web links to the original occurrence reports and investigation reports included. Occurrence reports whose status is Final are available through public ORPS; reports that are not Final are not available through public ORPS and require a valid ORPS login to view. All accepted investigation reports are available on the HSS web site.

Building 488 Tree Felling Injury at Brookhaven National Laboratory (ORPS Event SC—BHSO-BNL-BNL-2011-0005)

On Saturday, March 5, 2011 at approximately 10:20 a.m., a Brookhaven National Laboratory Building and Grounds Utility Worker was felling a pine tree while elevated in a 60-foot articulating and telescoping boom lift approximately 20-feet above the ground on the south side of Building 488. As the gas-powered, 20-inch chainsaw being used by the employee cut through the tree trunk, an approximately 8-foot long, 18-inch diameter, 520 pound section of tree trunk fell toward the aerial lift, striking the employee's right forearm, and compressing it against the top railing of the aerial lift basket.

Because of the severity of this injury and the prognosis of hospitalization of the employee in excess of 5 days, on March 8, 2011, the Department of Energy's Office of Science Brookhaven Site Office Manager formally appointed an Accident Investigation Board. The Accident Investigation Board was tasked with identifying all relevant facts to determine the direct, root, and contributing causes of the accident; developing conclusions; and determining Judgments of Need that, when implemented, should prevent recurrence of the accident. The Accident Investigation Board initiated the accident investigation on March 10, 2011.

The Accident Investigation Board concluded that this accident was preventable. The direct cause of this accident was the uncontrolled fall of the tree trunk section after it was cut loose from the pine tree. As best could be determined, the piece of trunk section struck the employee because the aerial lift basket was positioned at a place where gravity would cause the trunk section to fall. Though the trunk was leaning to the north/northeast (toward Building 488), it was believed that the employee expected the trunk section to fall away from the aerial lift basket after completing a downward angled (southeast to northwest) through-cut. However, as that cut was completed, gravity immediately allowed the already leaning trunk section to fall to the north/northeast and onto the employee.

The Accident Investigation Board identified two root causes: the Facilities and Operations Directorate(F&O) failed to conduct thorough hazard analyzes and implement effective work controls for protecting workers performing tree felling work; and the Facilities and Operations Directorate failed to ensure workers possessed needed skills to perform tree felling work, and have knowledge of industry work practices so as to recognize unsafe conditions. Three contributing causes were also identified: F&O failed to manage tree felling as greater than low ES&H risk work; F&O inadequately communicated management expectations on the use of a work permit for safely planning tree felling; and

F&O failed to ensure JRA-SI-SITEMAINT-16 addresses the hazards associated with tree felling work performed while elevated by an aerial lift.

Radiological Contamination Event During Separations Process Research Unit Building H2 Demolition, September 29, 2010 (ORPS Event EM--WGI-G2H2-2010-0001)

Background - On December 13, 2007, DOE announced the award of a four-year task order to Washington Group International (WGI) to provide deactivation, demolition, and removal of the SPRU nuclear facilities (Buildings G2, H2, the Tank Enclosures, and the connecting tunnel); cleanup and environmental restoration of the underlying and surrounding contaminated soil; and the decontamination of piping tunnel connecting the SPRU facilities to other operating facilities.

WGI was awarded additional funding from the American Recovery and Reinvestment Act by DOE to cover the costs associated with the current task order work scope as well as to accelerate the completion of the WGI contract scope from December 2011 to September 2011.

Accident Summary - On September 29, 2010, a radioactive contamination event occurred while performing open air demolition of Building H2 at the Separations Process Research Unit (SPRU) in Niskayuna, New York. Though initial indications demonstrated that low levels of contamination had been found on workers shoes and on KAPL property adjacent to the SPRU work activities, the magnitude and significance of the contamination event were not fully identified and understood by the SPRU project for several days. Based on the estimated cost to remediate the accident and event circumstances, a Type B investigation was ordered. On October 22, 2010, Mark Gilbertson, Deputy Assistant Secretary for Program and Site Support, U.S. Department of Energy, Office of Environmental Management (DOE-EM), formally appointed a Type B Accident Investigation Board to investigate the accident in accordance with DOE Order 225.1, Accident Investigations. The Board began the investigation on October 28, 2010, completed the investigation on November 11, 2010, and submitted findings to the Deputy Assistant Secretary for Program and Site Support on November 12, 2010.

By September 29, 2010, demolition of Building H2 had progressed to the point where the roof structure, the stack, and the exterior and interior walls with the exception of the north end above the 332' building elevation had been demolished and placed in intermodal containers for disposal. Demolition crews had removed an interior wall along the west half of the north end of the building the day before and were in the process of removing six evaporator system components that extended above and below the 332' elevation along the north-most outer wall. Following discussion in a 0800 morning meeting on September 29, 2010, the Cleveland Wrecking work group, with Washington Group International's (WGI) concurrence, proceeded to remove the following components from the north end of building footprint: evaporator condensers 221-A and 221-B, and columns 112-A, 112-B, and 113-B, which extended from the lower elevations of the building up above ground level, and size reduced condensers 221-A, 221- B, and column 113-B prior to identifying the spread of contamination event.

At approximately 1200, the demolition crew began to break for lunch. Workers exiting the area heard the frisker alarming and summoned a radiological controls technician (RCT) for assistance. The RCT discovered contaminated dust on the frisker and removed it. Personnel were directed out of the immediate area due to elevated background radiation readings in that area and conducted a frisk, finding contamination on both boots of each of the four equipment operators.

In response to the boot contamination event, further radiological surveys were conducted outside the demolition area and a review of air samplers surrounding the area was performed. Two perimeter air samples showed elevated readings but WGI determined these readings to be below reportable levels. Surveys were also conducted outside the demolition area. WGI and SPRU notified Knolls Atomic Power Laboratory (KAPL) of the radiological (boot contamination) event approximately at 1400. KAPL responded and started extensive surveys outside the SPRU boundary. WGI discontinued work in the area pending further investigation.

During the time of the event, KAPL had workers performing asphalt milling, roadway resurfacing preparations, and various other construction/operations activities to the east of the SPRU site. By the evening of September 29, 2010 KAPL's surveys had identified numerous areas of contamination on the grounds and some roofs in an area about 100 yards squared near the SPRU site. Based on survey results, KAPL performed bioassays on over 100 workers that were determined to be in the area on September 29, 2010 or workers that assisted in radiological surveys or subsequent clean up activities.

The next day, September 30, 2010 and into October 1, 2010, the SPRU project experienced exceptionally heavy rains due to Tropical Storm Nicole, greater than the 100 year rain. Rainfall totals were recorded at or above 7 inches.

The Board identified the open air demolition of the evaporator system components as the direct cause of the accident.

The Board identified two root causes for the accident. Eliminating these would have prevented the uncontrolled spread of contamination.

- The failures by WGI to fully understand, characterize, and control the radiological hazard.
- The failure by WGI to implement a work control process that ensured facility conditions supported proceeding with the work.

In addition, the board determined 20 contributing causes to the contamination accident.

Accident Investigation Training

HSS conducted Accident Investigator Training (SAF-230) courses at the US DOE Germantown facilities during the week of April 11, 2011. Additional courses are planned to be held at the National Training Center (NTC) the week of August 15th and Nevada Site Office the week of September 26th.

The Accident Investigator course scenario has been completely changed, and has received many good comments from those who have attended since the changes in April of 2010

To arrange for training, contact:

Ja'net N. Hollins
Safety Training Program
HSS/DOE NTC

phone: (505) 845-5170 x351
fax: (505) 845-5874